

SUPPORT FOR THE AMENDMENTS

Support for the amendment of Claim 1 is found in Claim 7 and on page 9, lines 4-8 in the specification. Claim 7 is herein canceled.

Claims 2, 3, 11-12, 16-17 and 20-22 are amended to use wording and structure consistent with U.S. patent law practice.

Support for the amendment of Claim 13 is found on page 6, lines 1-11, in the specification. Applicants respectfully submit that the vertical orientation relative to the electrode is a result of vertical growth.

Claim 26 is new and is supported by Claim 14. Claim 14 is herein canceled.

No new matter is believed to be added to this application by entry of this amendment.

Upon entry of this amendment, Claims 1-6, 8-13 and 15-26 are active. Claims 15, 19 and 25 are withdrawn.

REMARKS/ARGUMENTS

The claimed invention is directed to a photovoltaic device useful for converting light energy to electrical energy, i.e., generating electricity from light. Photovoltaic devices which are efficient in terms of energy conversion, convert light of longer wavelength, and are produced from relatively low cost organic materials are sought.

The claimed invention addresses this problem by providing a photovoltaic device comprising a composition of carbon nanotubes and of at least one organic hole conductor. The band gap of said carbon nanotubes lies in the range of from about 0.5 to about 1 eV and therefore lower energy light is absorbed by the carbon nanotubes and converted to electrical energy. No such photovoltaic device is disclosed or suggested by the cited references.

Applicants respectfully note that Claim 1 is herein amended to include the description: “wherein the band gap of said carbon nanotubes lies in the range of from about

0.5 to about 1 eV.” Applicants have described the significant improvement in conversion of lower energy light to electricity on page 10, lines 1-10, in the specification as follows:

The present invention provides for a network of electron- and hole-acceptors (and therefore also hole- and electron-donors) combining both a good charge carrier transfer from the donors to the acceptors and a good carrier mobility within the constituents of the network.

It furthermore provides for **a more effective absorption of light in the visible and near- infrared region, which distinguishes the devices according to the present invention from the devices of the prior art, e. g. organic solar cells based on fullerenes.** The absorption spectra of the latter are centered in the short wavelength region of the visible spectra and therefore, without wanting to be bound by any mechanistic theory, show minor power conversion efficiencies. (Bold added)

Applicants respectfully submit that since the band gap of the organic hole conductor is about 2 eV, i.e., is significantly larger than the band gap of the carbon nanotube system, the claimed photovoltaic covers a much wider range of photon energies. Therefore, the claimed device is better adjusted to the different spectra of commonly available light sources than conventional solar devices. Thus the claimed device will provide more efficient conversion of light independent of the irradiation source.

The rejection of Claims 1-4, 6, 8-10, 13-14, 16-18 and 21-24 under 35 U.S.C. 102(b) or in the alternative under 35 U.S.C. 103(a) over Kymakis et al. (Applied Physics Letters, American Institute of Physics. New York, Us vol. 80, no. 1,7, pages 112-114) is respectfully traversed.

Kymakis describes a photovoltaic device containing poly(3-octylthiophene) and single walled carbon nanotubes. Fig. 2 shows the Absorption spectra of the composite and in discussing the spectra, states:

“The absorption spectra of the P3OT show no significant change upon adding 1% of nanotubes by weight. This implies that in the blend, no significant ground state interaction is taking place between the two materials, . . . From the absorption spectra of the P3OT, an optical band gap of 2.4 eV can be derived.”

Further, on page 114, left column, lines 16-25, Kymakis describes that the workfunction of SWNTs ranges from 3.4 to 4 eV. Nowhere does this reference disclose or suggest carbon nanotubes having a band gap from about 0.5 to about 1 eV.

In view of the foregoing, Applicants respectfully submit that the cited reference can neither anticipate nor render obvious the invention as presently claimed. Accordingly, withdrawal of the rejection of Claims 1-4, 6, 8-10, 13-14, 16-18 and 21-24 under 35 U.S.C. 102(b) or in the alternative under 35 U.S.C. 103(a) over Kymakis is respectfully requested.

The rejection of Claims 1, 3-4, 7-8, 11 16-17 and 23-24 under 35 U.S.C. 102(b) or in the alternative under 35 U.S.C. 103(a) over Ago et al. (“Composites of Carbon Nanotubes and Conjugated Polymers for Photovoltaic Devices,” Advanced Materials, VCH Verlagsgesellschaft, Weinheim, DE, vol. 11, no.15, 20 October 1999 (1999-10-20), pages 1281-1285) is respectfully traversed.

The Examiner has cited Figure 4a; page 1284, column 2, lines 42-43 of Ago as describing the claimed photovoltaic device. However, Applicants respectfully point to the description beginning at line 5 in column 2 to understand the reference description.

“The structure of the photovoltaic devices is shown in Figure 4a, where PPV and MWNT layers have 210 and 140 nm thickness respectively. **The MWNT layer was used as the hole-collecting electrode, because of its relatively high conductivity (8 S/cm at room temperature)^[13] and high work function (5.1 eV)^[16].**” (Bold and underline added)

Applicants respectfully submit that nowhere does this reference disclose or suggest carbon nanotubes having a band gap in the range of from about 0.5 to about 1 eV. Moreover, the reference describes the MWNT layer as the electrode layer, not the layer intermediate between the two electrodes according to the claimed invention.

Applicants respectfully submit that a proper finding of anticipation requires that “[e]very element of the claimed invention ... be literally present, arranged as in the claim.

Perkin-Elmer Corp., 732 F.2d at 894, 221 USPQ at 673; *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 771-72, 218 USPQ 781, 789 (Fed. Cir. 1983), *cert. denied*, 465 U.S. 1026 [224 USPQ 520] (1984). The identical invention must be described in as complete detail in the reference as is described in the claimed invention.

Moreover, In the following excerpt from the Office's own discussion of **"Examination Guidelines for Determining Obviousness Under 35 U.S.C. 103 in View of the Supreme Court Decision in *KSR International Co. v. Teleflex Inc.*"** the Office has stated:

"The rationale to support a conclusion that the claim would have been obvious is that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art at the time of the invention.⁴³ "[I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does."⁴⁴ **If any of these findings cannot be made, then this rationale cannot be used to support a conclusion that the claim would have been obvious to one of ordinary skill in the art,**" (Federal Register, Vol. 72, No. 195, page 57529) **(Bold added)**

Applicants respectfully submit that based on the above, Ago neither meets the requirements for anticipation nor the requirements for obviousness. Accordingly, withdrawal of the rejection of Claims 1, 3-4, 7-8, 11 16-17 and 23-24 under 35 U.S.C. 102(b) or in the alternative under 35 U.S.C. 103(a) over Ago is respectfully requested.

The rejection of Claims 1, 3-6, 8, 10, 16-17 and 23-24 under 35 U.S.C. 102(b) or in the alternative under 35 U.S.C. 103(a) over Tsukamoto et al. (JP 2003-096313) is respectfully traversed.

Tsukamoto neither discloses nor suggests a device according to the claimed invention wherein a band gap of said carbon nanotubes lies in the range of from about 0.5 to about 1 eV.

Tsukamoto describes a Field Effect Transistor wherein a composite of carbon nanotubes and organic polymer is used as a semiconductor. This reference is silent with respect to a band gap for the carbon nanotubes and as described by the prior references and as discussed above, carbon nanotubes are generally known to have band gaps of 3 eV or higher.

Therefore, Applicants respectfully submit that a band gap of 0.5 to about 1 eV cannot be inherent to the description of this reference. As such description is neither explicit nor inherent, Applicants respectfully submit that the cited reference can neither anticipate nor render obvious the claimed invention. Withdrawal of the rejection of Claims 1, 3-6, 8, 10, 16-17 and 23-24 under 35 U.S.C. 102(b) or in the alternative under 35 U.S.C. 103(a) over Tsukamoto is respectfully requested.

The rejection of Claim 12 under 35 U.S.C. 103(a) over Kymakis or Ago or Tsukamoto further in view of Forrest et al. (U.S. 6,451,415) is respectfully traversed.

The deficiencies of each of the cited primary references has been described above. Forrest does not cure these basic deficiencies and therefore none of the cited combinations can render the claimed invention obvious.

Forrest describes photodetector organic photosensitive optoelectronic devices having multilayer structures and an exciton blocking layer. This reference is cited to show a multilayer structure. However, Forrest does not disclose or suggest multilayers containing carbon nanotubes having a band gap in the range of from about 0.5 to about 1 eV.

Therefore, Applicants respectfully submit that none of the cited combination of references can anticipate or render obvious the claimed invention. Withdrawal of the

rejection of Claim 12 under 35 U.S.C. 103(a) over Kymakis or Ago or Tsukamoto further in view of Forrest is respectfully requested.

The rejection of Claim 20 under 35 U.S.C. 103(a) over Kymakis further in view of Ganzorig et al. (Alkali metal acetates as effective electron injection layers for organic electroluminescent device,” Materials Science and Engineering B, Elsevier Sequoia, Lausanne, Ch, vol. 85 no. 2-3, 22 August 2001 (2001-08-22), pages 140-143) is respectfully traversed.

Ganzorig is cited to show a coating layer of alkali metal acetate of fluoride on an electrode. This reference describes a coating applied at the interface of an aluminum/tris(8-hydroxyquinoline)aluminum electrode/transfer layer. Nowhere does Ganzorig disclose or suggest a composite of carbon nanotubes and of at least one organic hole conductor, wherein the band gap of the carbon nanotubes lies in the range of from about 0.5 to about 1 eV.

In view of the above, Applicants respectfully submit that Ganzorig does not cure the basic deficiency of Kymakis previously described, and therefore, the cited combination of references cannot render the claimed invention obvious. Accordingly, withdrawal of the rejection of Claim 20 under 35 U.S.C. 103(a) over Kymakis further in view of Ganzorig is respectfully requested.

The rejection of Claims 1-14, 16-18 and 20-24 under 35 U.S.C. 112, second paragraph, is believed obviated by appropriate amendment. The phrase “compound acting as a” has been deleted from Claim 1. The claim now recites “at least one organic hole conductor.” An organic hole conductor is described on page 9, lines 4-8, in the specification. In view of this amendment, Applicants respectfully request withdrawal of the rejection of Claims 1-14, 16-18 and 20-24 under 35 U.S.C. 112, second paragraph.

Applicants wish to thank Examiner Ho for the discussion of product-by-process limitations on pages 4 and 5 of the Official Action, dated April 24, 2008. Applicants

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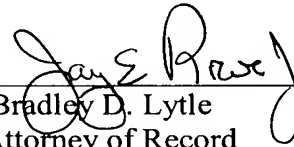
respectfully note that Claims 13 and 20-22 are herein amended to recite description not believed to be product-by-process format.

The title is herein amended to clearly indicate the claimed invention.

Applicants respectfully submit that the above-identified application is now in condition for allowance and early notice of such action is earnestly solicited.

Respectfully submitted,

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